Unit 4

Measurements and Symbols used in Plumbing

INTRODUCTION

In the previous Units, we have covered plumbing tools, material and pipes. Besides knowing the benefits and suitability of material in various tasks, a plumber must also be efficient in measurement of plumbing material with the help of measurement tools and be able to manage conversion of units easily. Similarly, a plumber should also be able to understand and read the various symbols used in plumbing drawings.

Plumbing material is needed as per the requirement of the plumbing work to be done and its plan. Plumbing fitting and fixtures are available in the market in different sizes and types. The size of the plumbing items can vary from inch to feet and metre in height. Plumbing items are also available as per volumetric capacity like water tanks, storage and flush tank, etc. Knowledge of various dimensions and sizes of plumbing items is crucial in the proper selection and purchasing of plumbing material in the market.
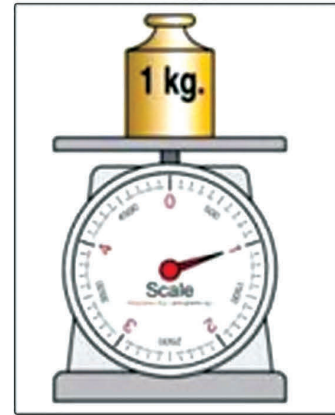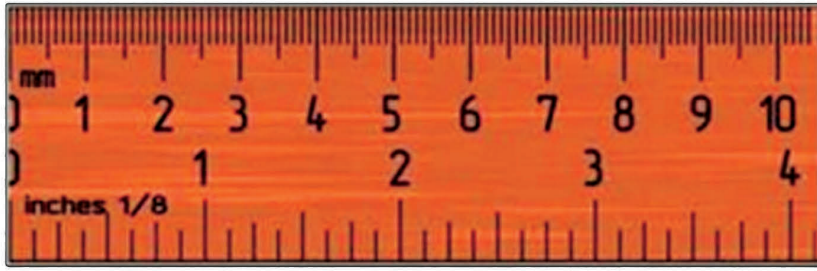
Fig. 4.1: Measuring scale

MEASUREMENT OF LENGTH

A plumber uses the metallic tape, cloth tape, scale and foot rule for measuring. Metallic tape should be used for accuracy in the measurement. Metre and its divisions are printed on the measuring tape. The symbol of feet is (′) and the symbol of inch is (″). For example, the meaning of 4′-9″ is four feet nine inches. Both the systems, i.e., metric system and FPS (Foot-Pound-Second) system are used in plumbing measurement.

(a) In metric systems

1 metre = 10 decimetre (dm)

1 metre = 100 centimetre (cm)

1 metre = 1000 millimetre (mm)

10 millimetre = 1 centimetre (cm)

10 centimetre = 1 decimetre (dm)

10 decimetre = 1 metre (m)

(b) In the FPS system

1 feet = 12 inches

3 feet = 1 yard

(c) Inter-relation of Metric and FPS system: Both type of systems can be interrelated, for taking length, in the following manner :

1 inch = 25.4 mm = 2.54 cm

1 metre = 39.37 inches = 1.09 yard
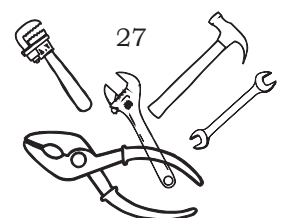
MEASUREMENT OF WEIGHT

Conversion Tables Weight

1 kilogram	= 10 hectograms
1 kilogram	= 100 decagram
1 kilogram	= 1000 gram
100 kilogram	= 1 quintal
1000 kilogram	= 1 metric ton
1 kilogram	= 2.2046 pounds

LENGTH CONVERSION

Length conversion is depicted in the following.

1millimetre (mm)	= 0.03937079 in, or about 1/25 in	
10 millimetre	= 1 centimetre (cm)	=0.3937079 in
10 centimetres	= 1 decimetre (dm)	=0.3937079 in
10 decimetres	= 1 metre (m)	= 39.37079 in, 3.2808992 ft, or 1.09361 yd
10 metres	= 1 decametre	= 32.808992 ft
10 decametres	= 1 hectometres	= 19.927817 rods
10 hectometres	= 1 kilometre (km)	= 1093.61 yd, or 0.621377 mile
10 kilometres	= 1 myriametre	= 6.21377 mile
1 inch	= 2.54 cm	1 foot = 0.3048 m 1 yard = 0.9144 m
1 rod	= 0.5029 decametre	1 mile = 1.6093 km

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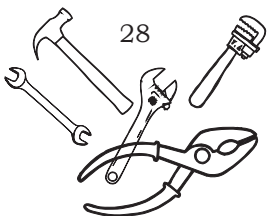
1 inch	= 2.54cm, 1 foot = 0.3048 m, 1 yard = 0.9144 metre
1 rod	= 0.5029 decametre
1 mile	= 1.6093 kilometre

Measurement of Volume

Conversion Table for Volume

Volume conversion is depicted in the following.

10 litres= 1 decilitre (dl) = 2.6417 gal, or 1.135 pk
10 decilitres = 1 hectolitre (Hl) = 2.8375 bu
10 hectolitres = 1 kilolitre (kl) = 61027.0515 cubic inch or 28.375 bu
1 cubic foot = 28.317
1 gallon (American) = 3.785 l
1 gallon (British) = 4.543 l
1 gallon = 4.546 litre

Measurement of Density

Density conversion is depicted below.

$1 \ lb/ft^3 = 16.018 \ kg/m^3$
$1 \ kg/m^3 = 0.0624 \ lb. \ /ft^3$
$1 \ lb/in^3 = 27.68 \ g/cm^3$

Measurement of Pressure

Pressure conversion is depicted below.

$1 \ lb/ft^2 = 4.8824 \ kg/m^3 = 1lb/metre^2 = 6.895 \ KgN/m^2$
$1 \ lb/inch^2 = 0.0703 \ kg/cm^3$

Comprehensive Conversion Table

Millimetres	= 25.400	× inches
Metres	× 3.2809	= feet

Measurements and Symbols used in Plumbing
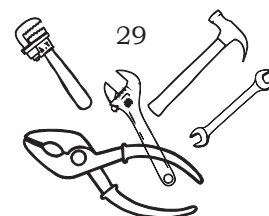
Metres	= 0.3048	× feet
Kilometres	× 0.621377	= miles
Kilometres	= 1.6093	× miles
Square centimetres	× 0.15500	= square inches
Square centimetres	= 6.4515	× square inches
Square metres	× 10.76410	= square feet
Square metres	= 0.09290	× square feet
Square kilometres	× 247.1098	= acres
Square kilometres	= 0.00405	× acres
Hectares	× 2.471	= acres
Hectares	0.4047	× acres
Cubic centimetre	× 0.061025	= cubic inches
Cubic centimetre	= 16.3266	× cubic inches
Cubic metre	× 35.3156	= cubic feet
Cubic metre	= 0.02832	× cubic feet
Cubic metre	× 1.308	= cubic yard
Cubic metre	= 0.765	× cubic yard
Litres	× 61.023	= cubic inches
Litres	= 0.01639	× cubic inches
Litres	× 0.26418	= U.S. gallons
Litres	= 3.7854	× U.S. gallons
Grams	× 15.4324	= grains
Grams	= 0.0648	× grains
Grams	× 0.03527	= Ounces, avoirdupois
Grams	= 28.3495	× Ounces, avoirdupois
Kilograms	× 2.2046	= pounds
Kilograms	= 0.4536	× pounds
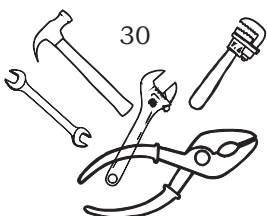
Kilogram per square centimetre	× 14.2231	= lb.per sqin
Kilogram per square centimetre	= 0.0703	× lbper sqin
Kilograms per cubic metre	× 0.06243	= lbper cuft
Kilograms per cubic metre	= 16.01890	× lbper cuft
Metric tons (1000 kilograms)	× 1.1023	× tons (2000 lb)
Metric tons (1000 kilograms)	= 0.9072	× tons (2000 lb)
Kilowatts	× 1.3405	= horse power
Kilowatts	= 0.746	× horse power
Calories	× 3.9683	= B.t.u
Calories	= 0.2520	× B.t.u
Francs	× 0.193	= dollars
Francs	= 5.18	× dollars

TIPS

(a) To know the circumference of a circle, multiply its diameter by 3.1416.

(b) To calculate the diameter of a circle, multiply the circumference by 0.31831.

(c) To calculate the area of circle, multiply the square of the diameter by 0.7854.

(d) To calculate the circumference, multiply the radius of a circle by 6.283185.

(e) To calculate the area, multiply the square of the circumference of a circle by 0.07958.

(f) To calculate the area, multiply the half the circumference of a circle with half its diameter.

(g) To calculate the radius, multiply the circumference of circle with 0.159155.

(h) To calculate the radius, multiply the square root of the area of circle with 0.56419.
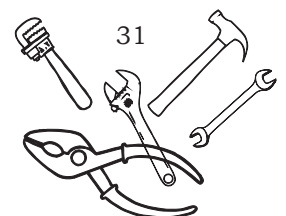
(i) To calculate the diameter, multiply the square root of the area of circle with 1.12838.

(j) To calculate the diameter of a circle equal in area to a given square, multiply a side of the square by 1.12838.

(k) To calculate the side of a square equal in area to a given circle, multiply the diameter by 0.8862.

(l) To calculate the side of a square inside a circle, multiply the diameter by 0.7071.

(m) To calculate the side of a hexagon inside in a circle, multiply the diameter of the circle by 0.500.

(n) To calculate the diameter of a circle inside in a hexagon, multiply the side of the hexagon by 1.7321.

(o) To calculate the side of an equilateral triangle inside in a circle, multiply the diameter of a circle by 0.866.

(p) To calculate the diameter of a circle inside in an equilateral triangle, multiply a side of the triangle by 0.57735.

(q) To calculate the area of the surface of a ball (sphere), multiply the square of the diameter by 3.1416.

(r) To calculate the volume of a ball (sphere), multiply the cube of the diameter by 0.5236.

(s) Doubling the diameter of a pipe increases its capacity four times.

(t) To calculate the pressure in pounds per square inch at the base of a column of water, multiply the height of the column in feet by 0.433.

(u) A gallon of water (U.S. standard) weighs 8.336 pounds and contains 231 cube inches. A cubic foot of water contains 7½ gallons, 1,728 cubic inches and weighs 62.425 pounds at a temperature of about 39°F. These weights change slightly and below this temperature.
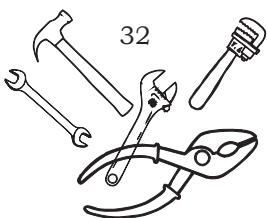
MEASURING INSTRUMENTS

Measuring tools

These are important tools in a workshop, which help the plumber to measure size and dimensions of various components of plumbing. Measuring tools are commonly used. A plumber should know the use and handling of these tools. The important measuring tools are steel rule, calliper, screw gauge, pressure gauge, etc.

Steel ruler

It is used to measure lengths and to draw straight lines (Fig. 4.2).

Fig. 4.2: Steel ruler

Calliper

It is a tool used to determine the shorter lengths between two sides of an item. The tips of the calliper are

Fig. 4.3: Outside callipers

Fig. 4.4: Inside callipers

kept to the distance to be measured; the calliper is then removed and the distance is measured between the tips with the ruler (Fig. 4.3 and Fig. 4.4).

Screw gauge (Micro metre)

It is a device incorporating a calibrated screw used widely for precise measurement of small lengths. Proper handling of this tool is important in measuring any dimension (Fig. 4.5).
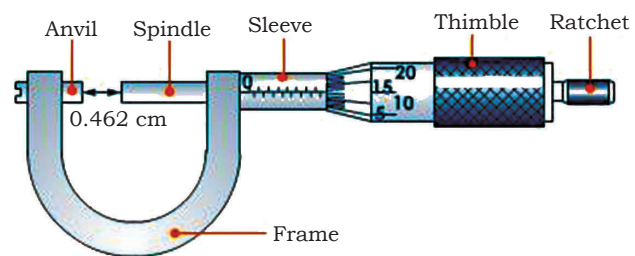
Fig. 4.5: Screw gauge

MEASUREMENTS AND SYMBOLS USED IN PLUMBING
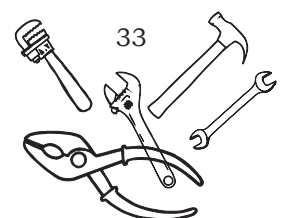
Measuring tape

Fig. 4.6: Measuring tape

It is used for measuring the dimension of plumbing items. Tapes are available in various lengths like 10 metres, 20 metres, etc. (Fig. 4.6)
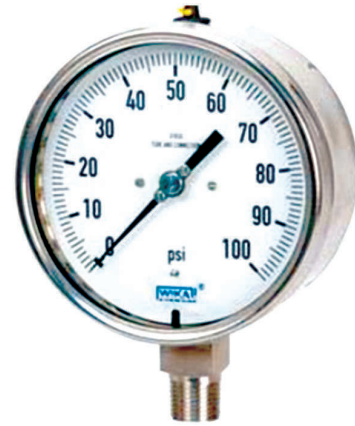
Pressure gauge

It is the instrument used for measuring the pressure in the unit (Fig. 4.7).

Fig. 4.7: Pressure gauge

① : used to take external measures of objects outside jaws
② : used to take internal measures of objects inside jaws
③ : used to measure the depth of objects depth probe
④ : (cm) Main scale
⑤ : (inch) Main scale
⑥ : (cm) Vernier
⑦ : (inch) Vernier
⑧ : used to block movable part retainer
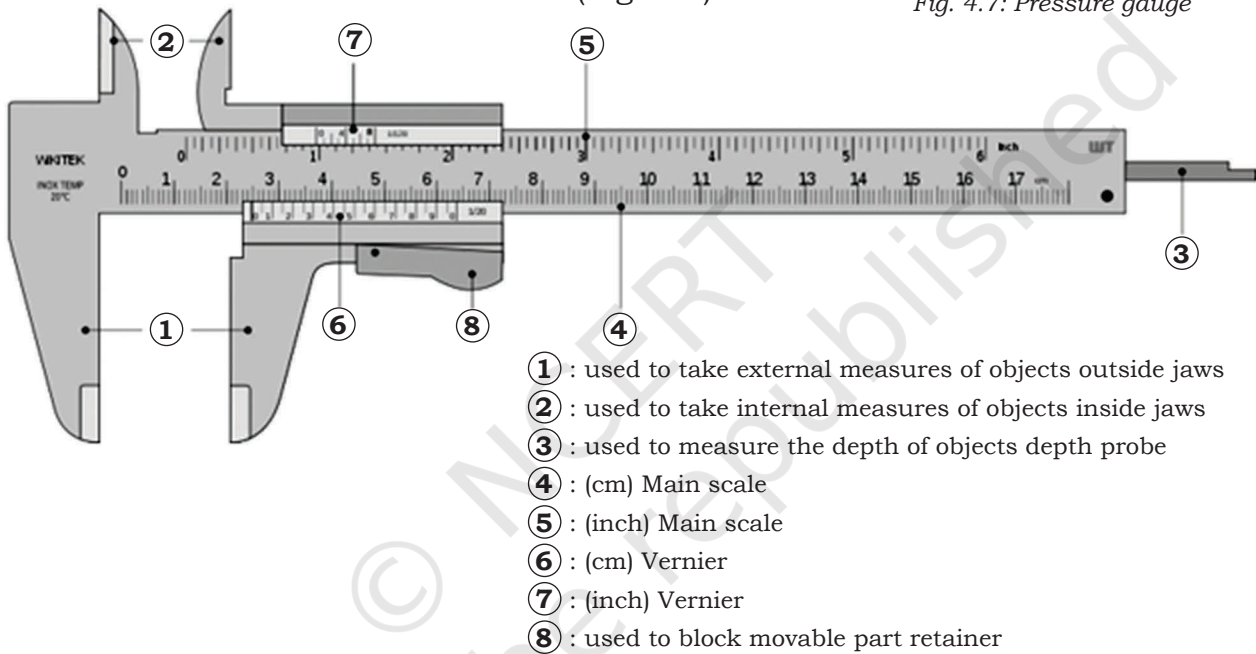
Fig. 4.8: Vernier calliper and its parts

Fig. 4.9: Vernier callipers

Vernier calliper

The metre scale is used to measure the length to the nearest millimetre only. For measuring smaller lengths precisely, Vernier calliper is used. **Vernier calliper** is a precision instrument used to measure the internal and external lengths. It is usually a manual calliper, as shown in Fig. 4.8 and Fig. 4.9.
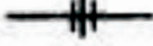
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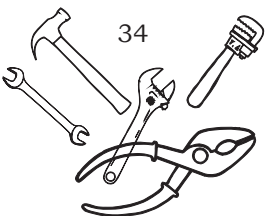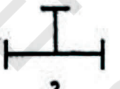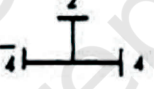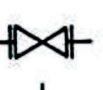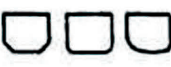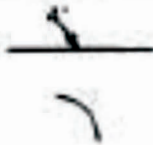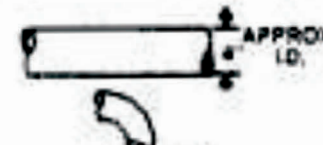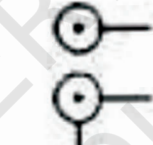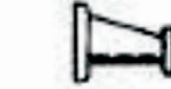
Plumbing Symbols

### Importance of plumbing symbols

A well-trained plumber does the installation of the fittings and fixtures as per the drawing given in the assembly sheet of the plumbing fixtures in the manufacturer's catalogue. These drawings consist of symbols, assembly of fixture and installation method. Identification of the symbols given in the drawings of fixtures makes the installation work easy for the plumber. Plumbing symbols are given in this Unit. The students should identify and learn the symbols so that it will be helpful in future.
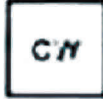
ITEM	SYMBOL	SAMPLE APPLICATION (S)	ILLUSTRATION
PIPE	SINGLE LINE IN SHAPE OF PIPE- USUALLY WITH NOMINAL SIZE NOTED		
JOINT- FLANGED	DOUBLE LINE		
SCREWED	SINGLE LINE		
BELL AND SPIGOT	CURVED LINE		
OUTLET TURNED UP	CIRCLE AND DOT		
OUTLET TURNED DOWN	SEMICIRCLE		
REDUCING OR ENLARGING FITTING	NORMAL SIZE NOTED AT JOINT		
REDUCER CONCENTRIC	TRIANGLE		
ECCENTRIC	TRIANGLE		
UNION SCREWED	LINE		
FLANGED	LINE		
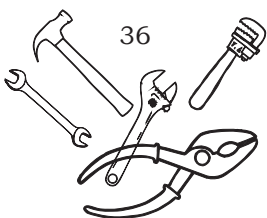
Symbol	Name	Symbol	Name
(M)	Water Meter	— - - —	Cold Water
— — - - - — —	Hot Water	- - - - - - - - - - -	Vent Line
————————	Sanitary Waste	— G —	Gas Pipe
Gate Valve symbol	Gate Valve	Water Heater Shut Off symbol	Water Heater Shut Off
(WC)	Water Closet	(LAV)	Lavatory
(WH)	Water Heater	DW	Dishwasher
CW	Clothes Washer	Floor Drain symbol	Floor Drain
Clean Out symbol	Clean Out	VTR	Vent Thru Roof
90 degree Elbow symbol	90 degree Elbow	Pipe Turns Up symbol	Pipe Turns Up
Pipe turns Down symbol	Pipe turns Down	Tee symbol	Tee
Union symbol	Union	Cap symbol	Cap
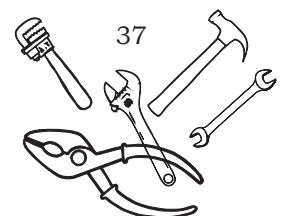
Activity 1

Measure the length, width and height of a room.

Material Required

1. Measuring tape
2. Copy
3. Pencil

Procedure

1. Collect the measuring tapes and scale.
2. Identify a room in which measurement can be made.
3. With the use of a measuring tape and scale, measure the length, breadth and height of the room.
4. Draw a rough drawing of the room and note down the dimensions.
5. Measure the dimensions in metres and convert into feet.

Activity 2

Measure the weight of a brick and cement bag

Material Required

1. Weighing unit
2. Brick
3. Cement bag
4. Notebook
5. Pencil

Procedure

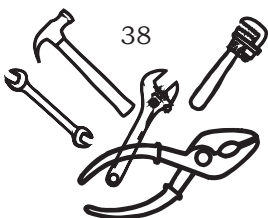1. Collect the brick and cement bag.
2. Check and calibrate the weighing unit.
3. Measure the weight of the brick and the cement bag separately.
4. Note down the weight of items in the copy.

Activity 3

Draw the plumbing symbols

Material Required

1. Plumbing symbols
2. Copy
3. Pen

Procedure

1. Draw the plumbing symbols given in this book.
2. Level the figure symbols.

Check Your Progress

A. Answer the following questions

1. Calculate the circumference of a circle of radius of 12cm.
2. A 4,800 litre water tank is ¾ full.
    (a) How much water is there in the tank?
    (b) How much is the empty space?
3. List the different types of material in which plumbing fittings are available.
4. Draw the figures of bends and reducing tee.

B. Fill in the blanks

1. 1 feet   = ...inches
2. 1 metre   = ...yards
3. 1 kilogram = ...pounds
4. 1 gallon   = ...litre
5. 1 lb/in^3 = ...g/cm^3
6. 10 decametres = ...hectometres

C. Mark the correct option

1. The function of a vernier calliper is to_____.
    (a) measure depth of a large container
    (b) measure diameter of a pipe
    (c) measure weight
    (d) measure pressure

2. Which of the following is a unit of length?
    (a) kg
    (b) m
    (c) minute
    (d) mL

3. Which of the following is a unit of area?
    (a) m^2
    (b) cm^2
    (c) Hectare
    (d) All of the above